



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Rajendra Solanki, et al.	§	Examiner:	Eric B. Fuller
Serial No:	10/081,426	§		
Date Filed:	02/22/2002	§	Group Art Unit:	1762
Title:	A Method of Depositing a Metallic Film on a Substrate	§	Docket No:	D8848-2

RULE 132 DECLARATION OF DR RAJENDRA SOLANKI

I, Rajendra Solanki, declare:

1. I am a named inventor on the above referenced patent application. A true and correct copy of my C.V. is attached as **Exhibit 1**, hereto.
2. I am a person skilled in the art of atomic layer deposition (“ALD”). The claims of the above referenced patent application pertain to the art of ALD.
3. ALD processes are technically distinct from chemical vapor deposition (CVD) processes. Each process produces films with different chemistries and structures.
4. The Norman and Cho patents cited in the Office Action dated May 18, 2004 disclose CVD processes, not ALD processes. Figure 1 of Cho discloses a “CVD REACTOR.”
5. The Cho patent discloses deposition of copper and aluminum films using CVD at Column 2, lines 41-49. Cho discloses the deposition of copper films by mixing isopropyl alcohol (IPA) and $\text{Cu}(\text{hfac})_2$ in a CVD reactor. Thus, Cho teaches away from ALD, as claimed in the present invention.

6. Introducing IPA and Cu(hfac)_2 at the same time in an ALD process, will alter the chemistry of the process.

7. Cho discloses the premixing of IPA with a Cu II source and hydrogen, instead of separately pulsing the sources, as in ALD (see Figure 1 and Columns 2-3 of Cho). Thus, Cho teaches away from the pulsing method of independent claims 1, 20, and 21 of the above referenced patent application.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

8/16/04
Date

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RAJ SOLANKI

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Education

Ph.D.	Physics, Colorado State University Fort Collins, Colorado	1982
M.S.	Physics, University of Illinois Urbana, Illinois	1975
B.S.	Physics, Dallas Baptist University Dallas, Texas	1973

Experience

6/99- present	Professor, Department of Electrical and Computer Engineering. Oregon Graduate Institute.
5/86 - 6/96	Associate Professor, ECE, Oregon Graduate Institute
10/83 - 7/84	Research Associate, Department of Electrical Engineering, Colorado State University
8/82 - 9/83	Postdoctoral Research Fellow, The Johns Hopkins University, Baltimore, Maryland

Background Summary

Involved in theoretical and experimental research in the following areas: conventional and photon-assisted growth, etch, and surface modification of electronic materials (group IV, III-V, II-VI), high speed optical (PIN detectors) and electronic (HBT) devices, modeling of carrier transport in semiconductors, gas discharges for materials processing and optical spectroscopy, atomic layer epitaxy for microelectronic film deposition, fabrication and characterization of organic and inorganic electroluminescent flat-panel displays, thin film transistors in polysilicon films, electrolytic deposition of Cu films for multi-level metallization, electromigration in Cu interconnects. bio- and nano-electronics.

Teaching Awards

Award for Innovation and Excellence in Teaching
Outstanding Teacher Award

Classes Taught

Have taught regular classes in Electrical and Computer Engineering Department, as well as the following specialty classes:

Quantum Electronics

Gaseous Electronics
Fiber Optics
Optical Memory Systems
Laser Processing of Semiconductors
Fundamentals of Gas Discharges
Applications of gas discharges
Engineering Optics I, II, III
Microelectronic Device Fabrication I, II, III
Flat Panel Displays
Electronic Properties of Materials
Electronic Materials and Device Characterization
Operation of Semiconductor Devices

MS and PhD Students:

Since 1986, have funded and supervised 8 MS theses and 16 PhD students. Currently supervising 3 PhD students and one Post- Doctoral Research Associate.

M.S. (thesis) students.

Diane Miller	Phillipe Cuaz
Lisa Volpel	Joy Alcantara.
Steve Brainard	Verivada Chandrasekaran
Willam J Morrison	Joao Simeous

Ph D Students (current employment)

Nyles Cody (Motorola)	Uppili Sudarsan (Maxim Semicond.)
Taner Dosluoglu (David Sarnoff Lab.)	Guy Silvestri (Lattice Semicond.).
Ding Li (Maxim Semicond.)	Weiran Kong (LSI Logic)
Shafqat Ahmed (Intel)	John Fogarty (Clarity Visual Sys.)
John Ferguson (Mentor Graphics)	Hui Zhang (WaferTech)
Aaron Marmorstein (IDT Semicond.)	Charlie Zhi (Novellus)
Hidayat Kisdarjono (Sharp Labs.)	Jinshan Huo (Air Liquide)
Bill Meyer (Intel)	Tudor Secasiu (Intel)
Barbero, post-doc (Wacker Siltronic)	

Professionsl activities

Organized OCATE seminar series on semiconductor technology (2 years)
Portland Area Semiconductor Seminar Series
Jim Hurd Display Technology seminar
Also involved in organizing special sessions at SPIE conferences.

Community Service:

Main activity consists of promoting science in k-12 schools.

Mentoring high school students. Every year have one or two high school students work in my lab.

Research Activity

Patents issued and pending:

1. "Blue-Violet Phosphor for Use in Electroluminescent Flat Panel Displays". Issued 1996, also licensed.
2. "Methods of using Atomic Layer Deposition to Deposit a High Dielectric Constant Material on a Substrate". Pat. # 6,420,279, issued July 16, 2002.
3. "A Method of Depositing a Metallic Film on a Substrate". Patent filed Feb. 2002.
4. "A Method of Electrically Detecting Molecules and Molecule-Molecule Interactions", filed Dec. 2002.
5. "Method to Deposit a Stacked High Gate Dielectric for CMOS applications", Pat# 6,686,212 issued Feb. 3, 2004.
6. "Atomic Layer Deposition (ALD) of HfO_2 / Al_2O_3 Nanolaminate Thin Film using $\text{Hf}(\text{NO}_3)_4$ as an Oxidizing Agent for Aluminum Precursors," filed April 2003.
7. "Methods of Planarizing Copper Electroplated Silicon Wafers", filed October 2003.
8. "Two Precursor Method to Perform Atomic Layer Deposition (ALD) of High Integrity Films," filed Feb. 2003.
9. "Method of Electrochemical Polishing of Patterned Copper Wafers", filed Jan. 2004.

Refereed Publications

J. Huo, R. Solanki, and J. McAndrew, "Electrochemical Planarization of Patterned Copper Films for Microelectronic Applications", J. Mater. Eng. And Perform. (to be published)

C. A. Decker, R. Solanki, J. Freeouf, J. R. Carruthers, and D. A. Evans, "Directed Growth of Nickel Silicide Nanowires", Appl. Phys. Lett. 84, 1389 (2004).

J. F. Conley, Y. Ono, R. Solanki, D. J. Tweet, "Pulsed Deposition of Metal- Oxide Thin Films using Dual Metal Precursors". Appl. Phys. Lett. 84, 398 (2004).

J. Huo, R. Solanki, and J. McAndrew, "Study of Anode Layer and its Effect on Electroplating of Bulk Copper and Electroplated Copper Films", J. Appl. Electrochem. 34, 305 (2004).

W. He, S.A. Schuetz, R. Solanki, J. Belot, and J. McAndrew, "Atomic Layer Deposition of Lanthanum Oxide Films for High-k Dielectrics", Electrochem. and Solid-State Lett. 7, G131 (2004).

J. Huo, R. Solanki, and J. McAndrew, "Electrochemical Planarization of Patterned Copper Films for Microelectronic Applications", Proc. 2nd International Surface Engineering Congress, pp 389-397, 2003.

W. He, R. Solanki, J. F. Conley, and Y. Ono, "Pulsed Deposition of Silicate Films", J. Appl. Phys. 94, 3657 (2003)

H. Kisdarjono, A. T. Voutsas, and R. Solanki, "3-Dimensional Simulations of Rapid Melting and Resolidification of Thin Si Films by Excimer Laser", J. Appl. Phys. 94, 4374 (2003)

J. Conley, Y. Ono, D. J. Tweet, G. Steckler, R. Solanki, "Electrical Properties of HfO_2 Deposited via Atomic Layer Deposition Using $\text{Hf}(\text{NO}_3)_4$ and H_2O ", Appl. Phys. Lett. 82, 3508 (2003)

J. Huo, J. McAndrew, and R. Solanki, "Electropolishing of Copper for Microelectronics Applications", J. Surface Engineering. 19, 11 (2003)

J. F. Conley, Y. Ono, D. J. Tweet, and R. Solanki, "Atomic Layer Deposition of Thin Oxide Films Using a Carbon Free Precursor", J. Appl. Phys. 93, 712 (2003).

J.F. Conley, Jr., Y. Ono, and R. Solanki, "Pulsed Deposition of HfO_2 using $\text{Hf}(\text{NO}_3)_4$ as an Oxidizing Agent for HfCl_4 ," in *CMOS Front-End Materials and Process Technology*, T.J. King, R.J.P. Lander, S. Saito, and B. Yu, eds., Mat. Res. Soc. Proc. Vol. 765, pp. 91-96, (Materials Research Society, Pittsburgh, PA, 2003).

W. Zhuang, J.F. Conley, Jr., Y. Ono, D.R. Evans, and R. Solanki, "Hafnium Nitrate Precursor Synthesis and Hafnium Oxide Thin Film Properties," Integrated Ferroelectrics 48, 3-12 (2002).

R. Solanki, J. Huo, J. F. Freeouf, and B. Miner, "Atomic layer Deposition of ZnSe/CdSe Superlattice Nanowires", Appl. Phys. Lett., 81, 3864, (2002)

J. Huo, R. Solanki, and J. McAndrew, "Characteristics of Copper Films Produced via Atomic Layer Deposition", J. Mat. Research . 17, 2394 (2002).

A. Y. Kang, P. M. Lenahan, J. F. Conley, and R. Solanki, "An Electron Spin Resonance Study of Interface Defects in ALCVD Hafnium Oxide on Si", Appl. Phys. Lett. 81, 1128 (2002)

J. F. Conley, Y. Ono, W. Zhuang, D. J. Tweet, S. K. Mohammed, and R. Solanki, "Atomic Layer Deposition of Hafnium Oxide Using Anhydrous Hafnium Nitrate", Electrochem. and Solid-State Lett., 5, C57 (2002)

J. F. Conley, Y. Ono, D. J. Tweet, W. Zhuang, and R. Solanki, "Atomic layer Deposition of Hafnium Oxide " in *Silicon Materials- Processing, Characterization,, and Reliability*, J. Veteran, D. L. O'Meara, V. Misra, P. Ho, eds., Mat. Res. Soc. Proc. Vol. 716, pp B2.2.1-6 (2002)

H. Kisdarjono, T. Voutsas, and R. Solanki, "Simulation of transient temperature profiles during ELA and relationship to process parameters", Proc. of Electronic Imaging 2001 (SPIE), San Jose, CA, 2001.

A.T. Voutsas, H. Kisdarjono, and R. Solanki, " Numerical Simulation of Non-Equilibrium, Ultra-Rapid Heating of Si thin Films by Nanosecond Pulsed Excimer Lasers", *Simulation of Semiconductor Processes and Devices*, Ed: D. Tsoukalas, and C. Tsamis, Springer Wien, New York, 2001.

H. Zhang and R. Solanki, " Atomic Layer Deposition of High Dielectric Constant Nanolaminates", J. Electrochem. Soc., 148, 63 (2001).

R. Solanki and B. Pathangey, "Atomic Layer Deposition of Copper Seed layers", Electrochemical and Solid State Letters, 3, 479 (2000).

(Invited) B. Pathangey and R. Solanki, "Atomic Layer Deposition for Nanoscale Thin Films", Vacuum Technology and Coatings, 1, 32 (2000).

H. Zhang, R. Solanki, B. Roberds, G. Bai, and I. Banerjee, " High Permittivity Thin Film Nanolaminates", J. Appl. Phys. 87, 1921 (2000).

A.T. Voutsas, M.A. Marmorstein, and R. Solanki, " The Effect of Laser Annealing Ambient on the Performance of Excimer Laser Annealed Thin Film Transistors", J. Electrochemical Soc. 146 , 3500 (1999).

A. Marmorstein, A. T. Voutsas, and R. Solanki "Effect of multiple scans and defects on excimer laser annealed polysilicon TFTs", Solid State Electronics, 43, 305 (1999).

A. Marmorstein, A. T. Voutsas, and R. Solanki, " A Systematic Study and Optimization of Parameters Affecting Grain Size and Surface roughness in Excimer Laser Annealed Polysilicon Thin Films", J. Appl. Phys. 82, 4303 (1997).

R. Engelmann, J. Ferguson, and R. Solanki, "Quantum Well Activated Phosphors-A New Concept for Electroluminescent Displays", Appl. Phys. Lett. 70, 411(1997).

A.T. Voutsas, A.M. Marmorstein, and R. Solanki, "Study of Parameters Affecting Material Characteristics Of XeCl Excimer Laser Annealed Polysilicon Thin Films" J. Applied Phys.

W. Kong, S. Ahmed, J. Ferguson, and R. Solanki, "Violet Light Emission from SrS:Eu Thin Film Electroluminescent Devices", Appl. Physics Lett. 67, 7(1995).

W. Kong, J. Fogarty, R. Solanki, and R. Tuenge, "White Light Emitting ZnS:Pr and SrS:Pr Electroluminescent devices Fabricated via Atomic Layer Epitaxy", Appl. Phys. Lett. 67, 460 (1995).

W. Kong, J. Fogarty, and R. Solanki, "Atomic Layer Epitaxy of ZnS:Tb Thin Film Electroluminescent Devices," Appl. Phys. Lett. 65, 936 (1994).

J. Fogarty, W. Kong, and R. Solanki, "Monte Carlo Simulation of High Field Electron Transport in ZnS," Solid-State Electronics, 38, 653 (1995).

J. Fogarty, W. Kong, and R. Solanki, "Monte Carlo Simulation of Electrical Characteristics of High Field AC Thin Film Electroluminescent Devices," SID Tech. Digest, vol. 25, p569 (1994).

W. Kong and R. Solanki, "The Effect of Ultraviolet Radiation on a ZnS:Tb Thin Film Electroluminescent Device," J. of Appl. Phys. 75, 3311 (1994).

D. M. Kim, J. W. Lee, T. Dosluoglu, and R. Solanki, "High Speed Lateral Polysilicon Photodiode," Semicond. Sci. Technol. 9, 1276 (1994).

T. Dosluoglu and R. Solanki, "Self-Consistent Calculations of Carrier Distribution and Energy Bands in InGaAs/InP PIN Diodes," Solid State Comm., 85, 243 (1993).

T. Dosluoglu, R. Gudimetla, and R. Solanki, "The Generalized Steady State Diode Equation: The State Equations Approach," Solid-State Electronics, 36, 273 (1993).

(Invited) R. Solanki, "Laser-Assisted Epitaxy of III-V Semiconductors," Proceedings of SPIE, 1804, 245 (1993).

U. Sudarsan, R. Devanthan, and R. Solanki, "Comparison of Defect Structure in Homo- and Heteroepitaxial GaP Grown Using Excimer Laser-Assisted MOVPE," J. of Materials Science, 26, 2309 (1991).

T. Dosluoglu and R. Solanki, "The Effect of InP Buffer Layer on the Electron Transport Properties of Epitaxial $\text{In}_{1-x}\text{Ga}_x\text{As}$," J. Appl. Phys. 69, 7327 (1991).

D. Dosluoglu, U. Sudarsan, and R. Solanki, "Relationship Between Gas Flows and Film Composition in Organometallic Vapor Phase Epitaxy of $\text{In}_{1-x}\text{Ga}_x\text{As}$," J. Crystal Growth, 106, 643 (1990).

F. A. Malik and R. Solanki, "Planarization of Dielectrics Used in the Manufacture of VLSI Circuits," Thin Solid Films, 193-194, 1030, (1990).

U. Sudarsan and R. Solanki, "Formation of Periodic Structures During Excimer Laser-Assisted Heteroepitaxy of GaP," J. Appl. Phys., 67, 2913 (1990).

U. Sudarsan, N. W. Cody, T. Dosluoglu, and R. Solanki, "Low Temperature Photon-Assisted Epitaxy of III-V semiconductors," Appl. Phys. A, 50, 325 (1990).

U. Sudarsan, N. W. Cody, T. Dosluoglu, and R. Solanki, "Ultraviolet Laser-Induced Low Temperature Epitaxy of GaP," Appl. Phys. Lett. 55, 738(1989).

N. W. Cody, U. Sudarsan, and R. Solanki, "Ultraviolet Photon-Assisted Heteroepitaxy of CdTe and $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$ on GaAs/Si Substrates," J. Appl. Phys. 66, 449 (1989).

N. W. Cody, U. Sudarsan, and R. Solanki, "Low Temperature Epitaxy of $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$," Laser and Particle Beam Chemical Processes on Surfaces, eds. A. W. Johnson, T. W. Sigmon, and G. L. Loper (North Holland, New York, 1989).

U. Sudarsan, N. W. Cody, and R. Solanki, "Laser-Induced Selective Etching of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ Films," J. Materials Science Letters, 8, 501(1989).

U. Sudarsan, T. Dosluoglu, N. W. Cody, and R. Solanki, "Selective Heteroepitaxy of GaP on Silicon," J. Crystal Growth, 94, 978 (1989).

N. W. Cody, U. Sudarsan, and R. Solanki, "Low Temperature CdTe Homoepitaxy at High Growth Rates," J. Appl. Phys., 65, 1932 (1989).

U. Sudarsan, T. Dosluoglu, N. W. Cody, and R. Solanki, "Argon Ion and Excimer Laser Induced Epitaxy of GaP," Laser and Particle Beam Chemical Processes on Surfaces, eds. A. W. Johnson, T. W. Sigmon, and G. L. Loper (North Holland, New York, 1989).

N. W. Cody, U. Sudarsan, and R. Solanki, "UV-Photon Induced Heteroepitaxy of CdTe on GaAs," J. Materials Research, 3, 1144 (1988).

U. Sudarsan, N. W. Cody, M. Bozack, and R. Solanki, "Excimer Laser Induced Sputtering of $\text{Y}_1\text{Ba}_2\text{Cu}_3\text{O}_{7-x}$," J. Materials Research 3, 825(1988).

N. W. Cody, U. Sudarsan, and R. Solanki, "Rapid Thermal Anneal of Sprayed $\text{Y}_1\text{Ba}_2\text{Cu}_3\text{O}_{7-x}$ Slurry," Appl. Phys. Lett. 52, 1531 (1988).

R. Solanki, U. Sudarsan, and J. C. Johnson, "Laser Induced Homoepitaxy of GaP," Appl. Phys. Lett. 52, 919 (1988).

(Invited) R. Solanki, "Photon-Assisted Processing of Electronic Materials," in Atomic and Molecular Processing of Electron and Ceramic Materials, ed. I. A. Aksay, T. G. Stoebe, G. L. McVay, and J. F. Wager (North Holland, New York, 1988).

D. M. Kim, F. Qian, R. Solanki, R. T. Tuenge, and C. N. King, "Rapid Thermal Anneal of Thin Film Electroluminescent Display Materials," in Fundamentals of Beam-Solid Interactions and Transient Processing, ed. M. J. Aziz, L. E. Rehn, and B. Stritzker (North Holland, New York, 1988).

G. A. Kovall, J. M. Matthews, and R. Solanki, "Mercury Lamp Induced Molybdenum Deposition," J. Vac. Sci. Technol. A 6, 2353 (1988).

G. A. Kovall and R. Solanki, "UV Photon-Induced Metallization," in Photon, Beam and Plasma Stimulated Chemical Processes at Surfaces, ed. V. M. Donnelly, I. P. Herman, and M. Hirose (North-Holland, New York, 1987).

(Invited) R. Solanki, "UV Laser Induced Thin Film Deposition," Optical Science and Engineering Series B. Advances in Laser Science. Eds. M. Lapp, W. C. Stwalley, and G. A. Kennedy (American Inst. of Physics, N. Y., 1987).

S. Srithavaran, R. Solanki, J. Fukumoto, N. Szluk, and D. Ellsworth, "Latch-up Free Lateral CMOS on Laser Recrystallized Silicon,: Beam-Solid Interactions and Phase Transformations, eds. H. Kurz, G. L. Olson, and J. Poate (North-Holland, New York 1986).

R. Solanki, G. A. Kovall, and J. M. Marrs, "Low Temperature Tungsten Deposition," Tungsten and Other Refractory Metals for VLSI Applications, ed. R. S. Blewer (North-Holland, New York 1986) p. 304.

G. A. Kovall and R. Solanki, "Photodeposition of Refractory Metals," Proceedings of Technical Symposium of Semicon East, Boston, MA, 1986, pp. 119-123.

(Invited) R. Solanki, C. A. Moore, and G. J. Collins, "Laser Induced Chemical Vapor Deposition," Solid State Technol. 28, 220 (1985).

A. Nudelfuden, R. Solanki, and H. W. Moos, "Spatial Imaging in the Soft X-Ray Region (20-304A) Utilizing the Astigmatism of a Grazing Incidence Concave Grating," Applied Optics 24, 789 (1985).

L. S. Hsu, R. Solanki, G. J. Collins, and C. Y. She, "Raman Study of Structural Transformations of Titania Coatings Induced by Laser Annealing," Appl. Phys. Lett. 45, 1065 (1984).

K. Emery, P. K. Boyer, R. Solanki, and G. J. Collins, "Thin Film Deposition by UV Laser Photolysis," Proc. SPIE, 459, 9 (1984).

P. K. Boyer, R. Solanki, W. K. Ritchie, and G. A. Roche, Laser Diagnostics and Photochemical Processing for Semiconductor Devices, eds. R. M. Osgood, S. R. Brueck, H. R. Schlossber (North-Holland, New York, 1983) Vol. 17, p. 119.

R. Solanki, W. H. Ritchie, and G. J. Collins, "Photodeposition of Aluminum Oxide and Aluminum Thin Films," Appl. Phys. Lett. 43, 454 (1983).

R. Solanki and G. J. Collins, "Laser Induced Deposition of Zinc Oxide," Appl. Phys. Lett. 42, 662 (1983).

(Invited) C. A. Moore, P. K. Boyer, W. K. Ritchie, and R. Solanki, "Microelectronic Thin Film Deposition by Laser Photolysis," Proc. SPIE, 385, 120 (1983).

(Invited) P. K. Boyer, C. A. Moore, W. K. Ritchie, and R. Solanki, "Laser Processing of Electronic Materials," Proc. of the 15th Conf. on Solid State Devices and Materials, Tokyo, Japan, 1983, pp. 109-115.

R. Solanki, P. K. Boyer, and G. J. Collins, "Low-Temperature Refractory Metal Film Deposition," Appl. Phys. Lett. 41, 1048 (1982).

R. Solanki, P. K. Boyer, J. E. Mahan, and G. J. Collins, "Laser Photodeposition of Refractory Metals," Appl. Phys. Lett. 38, 572 (1981).

R. Solanki, W. M. Fairbank, Jr., and G. J. Collins, "Multiwatt Operation of Cu II and Ag II Hollow Cathode Lasers," IEEE J. Quant. Elec. QE-16, 1292 (1980).

(Invited) D. C. Gerstenberger, R. Solanki, and G. J. Collins, "Metal Ion Hollow Cathode Lasers," IEEE J. Quant. Elec. QE-16, 820 (1980).

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R. Solanki, G. J. Collins, and W. M. Fairbank, Jr., "IR Laser Transition in a Nickel Hollow Cathode Discharge," IEEE J. Quant. Elec. QE-15, 525(1979).

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Conference presentations and seminars

"It's a small, small world", ECE Department seminar, Portland State University,, May 28, 2004.

"Evolution of micro-to nanoelectronics", ECE Department seminar, Colorado State University, April 12, 2004.

"Alternating Pulse Deposition of High-k Metal Oxide Thin Films using $\text{Hf}(\text{NO}_3)_4$ as a Metal and an Oxygen Source with Multiple in-situ Annealing," 204th Meeting of The Electrochemical Society, Orlando, FL, October 2003.

"Electrochemical polishing of patterned copper films for microelectronic applications", Int. Surface Engineering Congress, Indianapolis, IN, September 2003.

"Alternating Pulse Deposition of Metal Oxide Thin Films using $\text{Hf}(\text{NO}_3)_4$ as both a Metal and an Oxygen Source," 2003 AVS Topical Conference on Atomic Layer Deposition, San Jose, CA, July 2003.

"Near Threshold Electromigration of Damascene Copper on TiN", Materials Res. Soc. Spring Meeting, San Francisco, CA, April 2003.

"Thin HfO_2 Films Deposited via Alternating Pulses of $\text{Hf}(\text{NO}_3)_4$ and HfCl_4 ", Materials Res. Soc. Spring Meeting, San Francisco, CA, April 2003.

(Invited) "Evolution of Microelectronics to Nanoelectronics", Nano/Bio: Engineering Trends & Applications Conference, ASME, Portland, OR, April 2003.

"Modeling Laser Beam Spatial Separation Effects for Projection Laser Crystallization", SPIE, San Jose, CA, Jan. 2003.

(Invited) "Atomic Layer Deposition of Nanoscale Films" at special session of Nano-Structured Photonic Materials and Devices of IWCS, Orlando, FL, Nov. 2002

"Hafnium Nitrate Precursor Synthesis and Hafnium Oxide Thin Film Properties", ISIF 2002.

"High-k Dielectrics for Gate Applications", 2002 Spring Meeting of Materials Research Society, San Francisco, CA, April 2002.

"ALD of High-k Dielectrics using a New Modulated Temperature Tool", 2002 Topical Conference on Atomic Layer Deposition, Seoul, Korea, August 2002.

"Hafnium Nitrate Precursor Synthesis and Hafnium Oxide Thin Film Properties," 14th International Symposium on Ferroelectrics, Nara, Japan, May 2002

"Simulation of transient temperature profiles during ELA and relationship to process parameters", Electronic Imaging 2001 (SPIE), San Jose, CA, Jan 2001.

"Numerical Simulation of Non-Equilibrium, Ultra-Rapid Heating of Si thin Films by Nanosecond Pulsed Excimer Lasers", Simulation of Semiconductor Processes and Devices, Athens, Greece, 2001.

(Invited) Atomic Layer Deposition of Electronic Materials, ALD 2001, Monterey, CA, May, 2001.

"Investigation of Hafnium Oxide via Atomic Layer Chemical Vapor Deposition for MOSFET Gate Application", Integrated Reliability Workshop, Oct. 2001.

"High k Permittivity Dielectrics: What's the fuss about ?", Physics Department Seminar, OSU, Corvallis. Nov 26, 2001.

"The effect of oxygen on polysilicon TFT device performance", Electrochemical Soc. , San Jose , CA. 2000

"High permittivity dielectrics", American Chemical Society, Portland, OR, Aug. 2000.

"The effect of oxygen on polysilicon TFT device performance", Electrochemical Soc. Ext. Abst. 98-2, p667 (1998).

"Electroluminescent Displays" at New Displays, Flat Panel and Projection, San Jose, CA Feb. 1997

"Excimer laser crystallized polysilicon for thin film transistor applications", 9th International Symposium on Electronic Imaging, San Jose. Feb. 1997.

"A 200-lpi Active Matrix EL Display," Society for Information Display (SID), San Diego, CA, June, 1996.

(Invited) "Electroluminescent Displays," Short course on New Display Technologies, San Jose, CA, Feb. 1996.

"Simulation of Electrical Characteristics of ac Thin Film Electroluminescent Device", Society for Information Display Conference, San Jose, CA, June, 1994.

(Invited) "Laser Assisted Epitaxy of III-V Compounds," Microelectronics '92 (SPIE), San Jose, CA, September, 1992.

"The Planarization of Dielectrics Used in the Manufacture of VLSI Circuits," International Conf. on Thin Films, April, 1990.

"Low Temperature Epitaxy of $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$," Materials Research Society, Boston, MA, November-December, 1988.

"Argon Ion and Excimer Laser Induced Epitaxy of GaP," Materials Research Society, Boston, MA, November-December, 1988.

"Photo-Epitaxy of CdTe on GaAs,," Materials Research Society, Boston, MA, November-December, 1988.

" $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ Films on Silicon," Materials Research Society, Reno, NV, April 5, 1988.

"UV Photon Induced Heteroepitaxy of CdTe on GaAs," Gordon Conference on Chemistry of Electronic Materials, Venture, CA, March, 1988.

"Rapid Thermal Anneal of Thin Film Electroluminescent Display Materials," Materials Research Society, Boston, MA, November, 1987.

(Invited) "Photon-Assisted Processing of Electronic Materials," Atomic and Molecular Processing of Electronic and Ceramic Materials, Seattle, WA, August, 1987.

"Mercury Lamp Induced Deposition of W and Mo," Materials Research Society, Boston, MA, December 1-5, 1986.

(Invited) "UV Photon-Assisted Thin Film Deposition," International Laser Science Conference, Seattle, WA, October 20-24, 1986.

(Invited) "Photodeposition of Metallic Films," American Society for Metals, Orlando, FL, October 4-7, 1986.

"UV Photon-Assisted Deposition of Refractory Metal Films," Semicon East, Boston, MA, December 1-6, 1985.

(Invited) "Beam Processing of Thin Films," Materials Research Society, Boston, MA, December 1-6, 1985.

"Effect of Far Ultraviolet Radiation (Excimer Laser) on the Adult Spinal Cord of Rat," Conference of the Society of Neuroscience, Dallas, TX, October 1985.

"Lateral CMOS on Laser Recrystallized Silicon," IEEE SOS/SOI Technology Workshop, Park City, UT, October 1985.

"Electron and Photon Beam Processing of Microelectronic Films," 32nd Industrial Affiliates Symposium, Stanford University, CA, September 4-6, 1985.

"Low Temperature Deposition of Mo," International Conference on Metallurgical Coatings, Los Angeles, CA, April 1985.

"Photodeposition of Refractory Metals for VLSI Applications," Gordon Research Conference on Chemistry of Electronic Materials, Santa Barbara, CA, February 1985.

"Laser Induced Growth of Silicon and Indium Phosphide Native Oxides," Materials Research Conference, Boston, MA, November 1984.

"Photolytic Deposition of Tungsten," Symposium on Tungsten for VLSI Applications, Sandia Laboratory, NM, November 1984.

"Electron and Laser Beam Assisted Deposition of Electronic Films," Gordon Research Conference on Plasma Chemistry, Tilton, NH, August 1984.

(Invited) "Laser Processing of Electronic Materials," Clarendon Laboratory, Oxford University, May 1984.

(Invited) "Laser Induced Deposition of Refractory Metals and Insulators," Symposium on "Photolytic Deposition of Metals, Semiconductors, and Dielectrics," The Rank Prize Funds, Malvern, England, April 1984.

"Laser and Electron Beam Induced Deposition of Metals and Insulators,": International Conference on Metallurgical Coatings, San Diego, CA, April, 1984.

(Invited) "Thin Film Deposition by Laser Photolysis," The International Society for Optical Engineering (SPIE), Los Angeles, CA, January 1984.

(Invited) "Microelectronic Thin Film Deposition by UV Laser Photolysis." 15th Conference on Solid State Devices and Materials, Tokyo, Japan, 1983.

"Time Resolving Multispatial Grazing Incidence Spectrograph for Plasma Fusion Diagnostics," American Physical Society, Division of Plasma Physics, Los Angeles, CA, November 1983.

"Spatially Resolving Soft X-Ray Spectrometer," IEEE International Conference on Plasma Science, San Diego, CA, May 1983.

"Photodeposition of Thin Films," Conference on Lasers and Electro-Optics (CLEO), Baltimore, MD, May 1983.

(Invited) "Microelectronic Thin Film Deposition by Laser Photolysis," The International Society for Optical Engineering (SPIE), Los Angeles, CA, January 1983.

"Laser Photolytic Deposition of Thin Films," Materials Research Conference, Boston, MA, November, 1982.

"Laser Photodeposition of Refractory Metals," Conference on Lasers and Electro-Optics (CLEO), Washington, D. C., June 1981.

Research Reported as News

Si nanowire work reported in:

Daily Journal of Commerce, Feb. 26, 2004

Columbian (Vancouver, WA), Feb. 24, 2004

The Tribune, March 2, 2004

The Oregonian, Feb. 24, 2004

The Business Journal (Portland), Feb. 23, 2004.

USA Today (web), Feb. 24, 2004.
The Miami Herald (web), Feb. 24, 2004.
EE Times, March 8, 2004

"ALE process resurfaces," Electronic Engineering Times, Feb. 27, 1995. p 37.

"Oregon research team bands semiconductor-superconductor," The Oregonian, May 26, 1988.

"OGC scientists eye superconductivity breakthrough," Daily Journal of Commerce, June 3, 1988.

"High T_c Film on Silicon," Advanced Manufacturing Technology, June 13, 1988.

"The cutting edge of technology," This Week, June 29, 1988.

"Scientists deposit superconducting films on silicon, SiO₂, and sapphire," Semiconductor International, July, 1988.

"Superconducting films on silicon," Inside R & D, June 1988.

"Superconductors on Silicon Wafers," Solid State Technology, September, 1988.